



## N-CHANNEL MOSFET

**Qualified per MIL-PRF-19500/592**

Qualified Levels:  
JAN, JANTX, and  
JANTXV

### DESCRIPTION

This family of switching transistors is military qualified up to the JANTXV level for high-reliability applications. These devices are also available in a low profile U surface mount package. Microsemi also offers numerous other transistor products to meet higher and lower power ratings with various switching speed requirements in both through-hole and surface-mount packages.

**Important:** For the latest information, visit our website <http://www.microsemi.com>.

### FEATURES

- JEDEC registered 2N7224, 2N7225, 2N7227 and 2N7228 number series.
- JAN, JANTX, and JANTXV qualifications are available per MIL-PRF-19500/592.  
(See [part nomenclature](#) for all available options.)
- RoHS compliant by design.

### APPLICATIONS / BENEFITS

- Low-profile design.
- Military and other high-reliability applications.

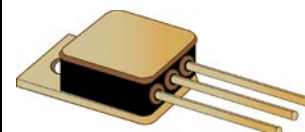
### MAXIMUM RATINGS @ T<sub>A</sub> = +25°C unless otherwise stated

| Parameters / Test Conditions                                |                                          | Symbol                            | Value       | Unit   |
|-------------------------------------------------------------|------------------------------------------|-----------------------------------|-------------|--------|
| Operating & Storage Junction Temperature Range              |                                          | T <sub>J</sub> & T <sub>stg</sub> | -55 to +150 | °C     |
| Thermal Resistance Junction-to-Case                         |                                          | R <sub>θJC</sub>                  | 0.83        | °C/W   |
| Total Power Dissipation                                     | @ T <sub>A</sub> = +25 °C                | P <sub>T</sub>                    | 4           | W      |
|                                                             | @ T <sub>C</sub> = +25 °C <sup>(1)</sup> |                                   | 150         |        |
| Gate-Source Voltage, dc                                     |                                          | V <sub>GS</sub>                   | ± 20        | V      |
| Drain Current, dc @ T <sub>C</sub> = +25 °C <sup>(2)</sup>  | 2N7224                                   | I <sub>D1</sub>                   | 34.0        | A      |
|                                                             | 2N7225                                   |                                   | 27.4        |        |
|                                                             | 2N7227                                   |                                   | 14.0        |        |
|                                                             | 2N7228                                   |                                   | 12.0        |        |
| Drain Current, dc @ T <sub>C</sub> = +100 °C <sup>(2)</sup> | 2N7224                                   | I <sub>D2</sub>                   | 21          | A      |
|                                                             | 2N7225                                   |                                   | 17          |        |
|                                                             | 2N7227                                   |                                   | 9           |        |
|                                                             | 2N7228                                   |                                   | 8           |        |
| Off-State Current (Peak Total Value) <sup>(3)</sup>         | 2N7224                                   | I <sub>DM</sub>                   | 136         | A (pk) |
|                                                             | 2N7225                                   |                                   | 110         |        |
|                                                             | 2N7227                                   |                                   | 56          |        |
|                                                             | 2N7228                                   |                                   | 48          |        |
| Source Current                                              | 2N7224                                   | I <sub>S</sub>                    | 34.0        | A      |
|                                                             | 2N7225                                   |                                   | 27.4        |        |
|                                                             | 2N7227                                   |                                   | 14.0        |        |
|                                                             | 2N7228                                   |                                   | 12.0        |        |

- NOTES:**
1. Derated linearly by 1.2 W/°C for T<sub>C</sub> > +25 °C.
  2. The following formula derives the maximum theoretical ID limit. ID is limited by package and internal wires and may also be limited by pin diameter:

$$I_D = \sqrt{\frac{T_J(\text{max}) - T_C}{R_{\theta JC} \times R_{DS(on)} @ T_J(\text{max})}}$$

3. I<sub>DM</sub> = 4 × I<sub>D1</sub> as calculated in note 2.



**TO-254AA Package**

Also available in:

**U (SMD-1 or TO-267AB) package**  
(surface mount)  
 [2N7224U & 2N7228U](#)

#### **MSC – Lawrence**

6 Lake Street,  
Lawrence, MA 01841  
Tel: 1-800-446-1158 or  
(978) 620-2600  
Fax: (978) 689-0803

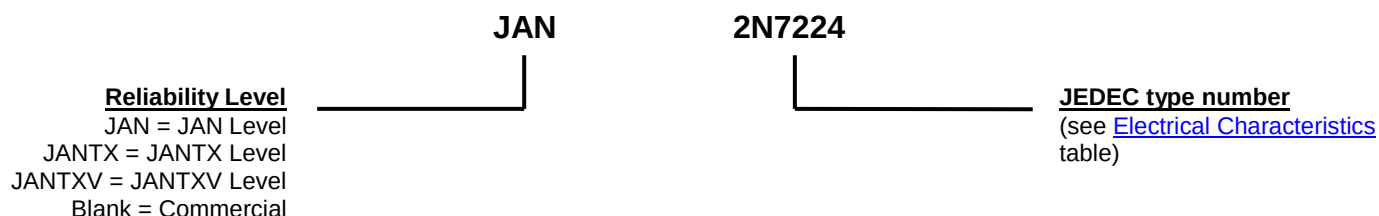
#### **MSC – Ireland**

Gort Road Business Park,  
Ennis, Co. Clare, Ireland  
Tel: +353 (0) 65 6840044  
Fax: +353 (0) 65 6822298

**Website:**  
[www.microsemi.com](http://www.microsemi.com)

**MECHANICAL and PACKAGING**

- CASE: Ceramic and gold over nickel plated steel.
- TERMINALS: Gold over nickel plated tungsten/copper.
- MARKING: Part number, date code, and polarity symbol.
- WEIGHT: 6.5 grams.
- See [Package Dimensions](#) on last page.

**PART NOMENCLATURE**

**SYMBOLS & DEFINITIONS**

| Symbol   | Definition                                                                                 |
|----------|--------------------------------------------------------------------------------------------|
| $di/dt$  | Rate of change of diode current while in reverse-recovery mode, recorded as maximum value. |
| $I_F$    | Forward current                                                                            |
| $R_G$    | Gate drive impedance                                                                       |
| $V_{DD}$ | Drain supply voltage                                                                       |
| $V_{DS}$ | Drain source voltage, dc                                                                   |
| $V_{GS}$ | Gate source voltage, dc                                                                    |

**ELECTRICAL CHARACTERISTICS @  $T_A = +25^\circ\text{C}$ , unless otherwise noted**

| Parameters / Test Conditions                                                                                                                                                                                                                                                                                         |                                      | Symbol                                          | Min.                     | Max.                             | Unit          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------------|--------------------------|----------------------------------|---------------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                           |                                      |                                                 |                          |                                  |               |
| Drain-Source Breakdown Voltage<br>$V_{GS} = 0\text{ V}, I_D = 1.0\text{ mA}$                                                                                                                                                                                                                                         | 2N7224<br>2N7225<br>2N7227<br>2N7228 | $V_{(BR)DSS}$                                   | 100<br>200<br>400<br>500 |                                  | V             |
| Gate-Source Voltage (Threshold)<br>$V_{DS} \geq V_{GS}, I_D = 0.25\text{ mA}$<br>$V_{DS} \geq V_{GS}, I_D = 0.25\text{ mA}, T_J = +125^\circ\text{C}$<br>$V_{DS} \geq V_{GS}, I_D = 0.25\text{ mA}, T_J = -55^\circ\text{C}$                                                                                         |                                      | $V_{GS(th)1}$<br>$V_{GS(th)2}$<br>$V_{GS(th)3}$ | 2.0<br>1.0               | 4.0<br>5.0                       | V             |
| Gate Current<br>$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$<br>$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}, T_J = +125^\circ\text{C}$                                                                                                                                                                         |                                      | $I_{GSS1}$<br>$I_{GSS2}$                        |                          | $\pm 100$<br>$\pm 200$           | nA            |
| Drain Current<br>$V_{GS} = 0\text{ V}, V_{DS} = 80\text{ V}$<br>$V_{GS} = 0\text{ V}, V_{DS} = 160\text{ V}$<br>$V_{GS} = 0\text{ V}, V_{DS} = 320\text{ V}$<br>$V_{GS} = 0\text{ V}, V_{DS} = 400\text{ V}$                                                                                                         | 2N7224<br>2N7225<br>2N7227<br>2N7228 | $I_{DSS1}$                                      |                          | 25                               | $\mu\text{A}$ |
| Drain Current<br>$V_{GS} = 0\text{ V}, V_{DS} = 80\text{ V}, T_J = +125^\circ\text{C}$<br>$V_{GS} = 0\text{ V}, V_{DS} = 160\text{ V}, T_J = +125^\circ\text{C}$<br>$V_{GS} = 0\text{ V}, V_{DS} = 320\text{ V}, T_J = +125^\circ\text{C}$<br>$V_{GS} = 0\text{ V}, V_{DS} = 400\text{ V}, T_J = +125^\circ\text{C}$ | 2N7224<br>2N7225<br>2N7227<br>2N7228 | $I_{DSS2}$                                      |                          | 0.25                             | mA            |
| Static Drain-Source On-State Resistance<br>$V_{GS} = 10\text{ V}, I_D = 21.0\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 17.0\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 9.0\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 8.0\text{ A pulsed}$                                                        | 2N7224<br>2N7225<br>2N7227<br>2N7228 | $r_{DS(on)1}$                                   |                          | 0.070<br>0.100<br>0.315<br>0.415 | $\Omega$      |
| Static Drain-Source On-State Resistance<br>$V_{GS} = 10\text{ V}, I_D = 34.0\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 27.4\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 14.0\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 12.0\text{ A pulsed}$                                                      | 2N7224<br>2N7225<br>2N7227<br>2N7228 | $r_{DS(on)2}$                                   |                          | 0.081<br>0.105<br>0.415<br>0.515 | $\Omega$      |
| Static Drain-Source On-State Resistance<br>$T_J = +125^\circ\text{C}$<br>$V_{GS} = 10\text{ V}, I_D = 21.0\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 17.0\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 9.0\text{ A pulsed}$<br>$V_{GS} = 10\text{ V}, I_D = 8.0\text{ A pulsed}$                          | 2N7224<br>2N7225<br>2N7227<br>2N7228 | $r_{DS(on)3}$                                   |                          | 0.11<br>0.17<br>0.68<br>0.90     | $\Omega$      |
| Diode Forward Voltage<br>$V_{GS} = 0\text{ V}, I_D = 34.0\text{ A pulsed}$<br>$V_{GS} = 0\text{ V}, I_D = 27.4\text{ A pulsed}$<br>$V_{GS} = 0\text{ V}, I_D = 14.0\text{ A pulsed}$<br>$V_{GS} = 0\text{ V}, I_D = 12.0\text{ A pulsed}$                                                                            | 2N7224<br>2N7225<br>2N7227<br>2N7228 | $V_{SD}$                                        |                          | 1.8<br>1.9<br>1.7<br>1.7         | V             |

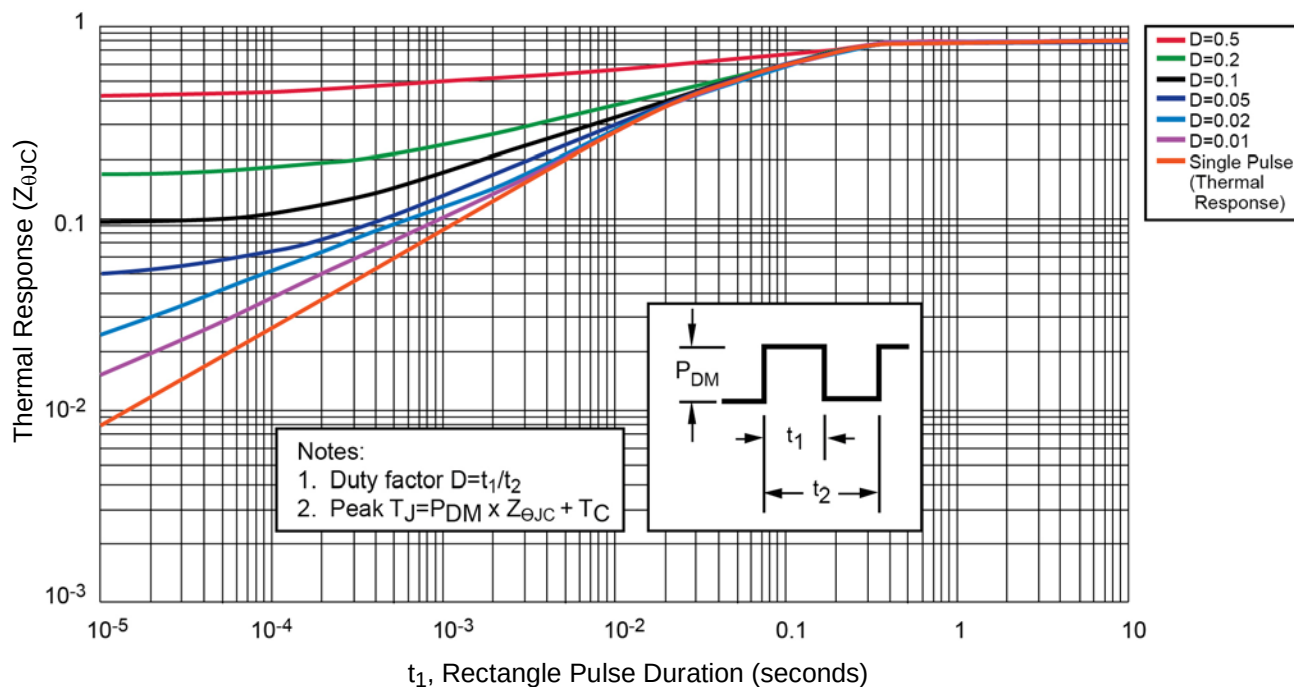
**ELECTRICAL CHARACTERISTICS @  $T_A = +25\text{ }^{\circ}\text{C}$ , unless otherwise noted (continued)**
**DYNAMIC CHARACTERISTICS**

| Parameters / Test Conditions                                                   | Symbol      | Min. | Max. | Unit |
|--------------------------------------------------------------------------------|-------------|------|------|------|
| <b>Gate Charge:</b>                                                            |             |      |      |      |
| On-State Gate Charge                                                           | $Q_{g(on)}$ |      |      | nC   |
| $V_{GS} = 10\text{ V}$ , $I_D = 34.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7224 |             |      | 125  |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 27.4\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7225 |             |      | 115  |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 14.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7227 |             |      | 110  |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 12.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7228 |             |      | 120  |      |
| Gate to Source Charge                                                          | $Q_{gs}$    |      |      | nC   |
| $V_{GS} = 10\text{ V}$ , $I_D = 34.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7224 |             |      | 22   |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 27.4\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7225 |             |      | 22   |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 14.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7227 |             |      | 18   |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 12.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7228 |             |      | 19   |      |
| Gate to Drain Charge                                                           | $Q_{gd}$    |      |      | nC   |
| $V_{GS} = 10\text{ V}$ , $I_D = 34.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7224 |             |      | 65   |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 27.4\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7225 |             |      | 60   |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 14.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7227 |             |      | 65   |      |
| $V_{GS} = 10\text{ V}$ , $I_D = 12.0\text{ A}$ , $V_{DS} = 50\text{ V}$ 2N7228 |             |      | 70   |      |

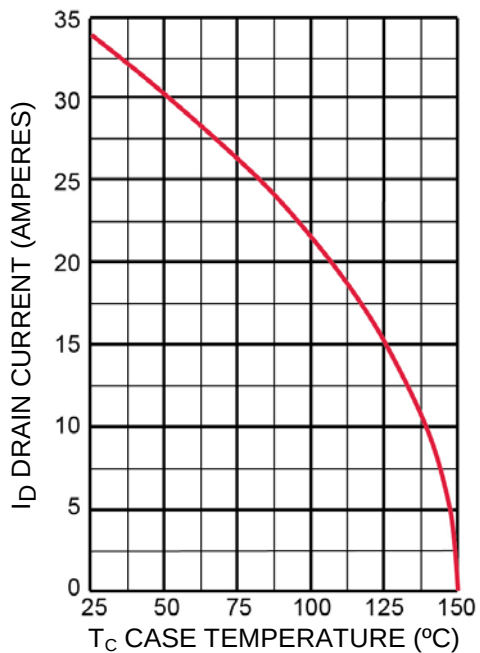
**SWITCHING CHARACTERISTICS**

| Parameters / Test Conditions                                                                                 | Symbol       | Min. | Max. | Unit |
|--------------------------------------------------------------------------------------------------------------|--------------|------|------|------|
| Turn-on delay time                                                                                           | $t_{d(on)}$  |      |      | ns   |
| $I_D = 34.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 50\text{ V}$ 2N7224  |              |      |      |      |
| $I_D = 27.4\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 100\text{ V}$ 2N7225 |              |      | 35   |      |
| $I_D = 14.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 200\text{ V}$ 2N7227 |              |      |      |      |
| $I_D = 12.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 250\text{ V}$ 2N7228 |              |      |      |      |
| Rinse time                                                                                                   | $t_r$        |      |      | ns   |
| $I_D = 34.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 50\text{ V}$ 2N7224  |              |      |      |      |
| $I_D = 27.4\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 100\text{ V}$ 2N7225 |              |      | 190  |      |
| $I_D = 14.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 200\text{ V}$ 2N7227 |              |      |      |      |
| $I_D = 12.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 250\text{ V}$ 2N7228 |              |      |      |      |
| Turn-off delay time                                                                                          | $t_{d(off)}$ |      |      | ns   |
| $I_D = 34.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 50\text{ V}$ 2N7224  |              |      |      |      |
| $I_D = 27.4\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 100\text{ V}$ 2N7225 |              |      | 170  |      |
| $I_D = 14.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 200\text{ V}$ 2N7227 |              |      |      |      |
| $I_D = 12.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 250\text{ V}$ 2N7228 |              |      |      |      |
| Fall time                                                                                                    | $t_f$        |      |      | ns   |
| $I_D = 34.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 50\text{ V}$ 2N7224  |              |      |      |      |
| $I_D = 27.4\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 100\text{ V}$ 2N7225 |              |      | 130  |      |
| $I_D = 14.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 200\text{ V}$ 2N7227 |              |      |      |      |
| $I_D = 12.0\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 2.35\text{ }\Omega$ , $V_{DD} = 250\text{ V}$ 2N7228 |              |      |      |      |
| Diode Reverse Recovery Time                                                                                  | $t_{rr}$     |      |      | ns   |
| $di/dt \leq 100\text{ A}/\mu\text{s}$ , $V_{DD} \leq 30\text{ V}$ , $I_F = 34.0\text{ A}$ 2N7224             |              |      | 500  |      |
| $di/dt \leq 100\text{ A}/\mu\text{s}$ , $V_{DD} \leq 30\text{ V}$ , $I_F = 27.4\text{ A}$ 2N7225             |              |      | 950  |      |
| $di/dt \leq 100\text{ A}/\mu\text{s}$ , $V_{DD} \leq 30\text{ V}$ , $I_F = 14.0\text{ A}$ 2N7227             |              |      | 1200 |      |
| $di/dt \leq 100\text{ A}/\mu\text{s}$ , $V_{DD} \leq 30\text{ V}$ , $I_F = 12.0\text{ A}$ 2N7228             |              |      | 1600 |      |

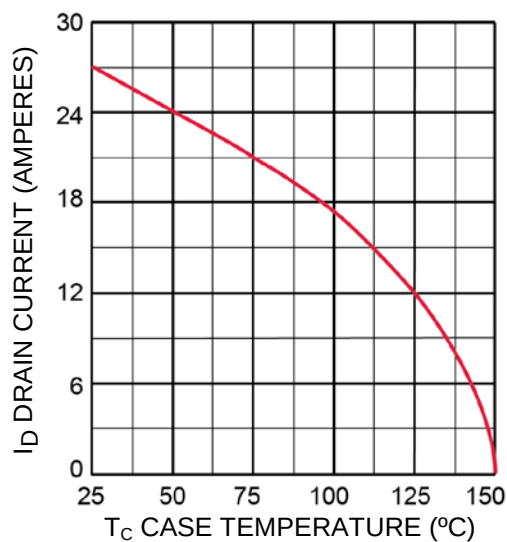
# GRAPHS



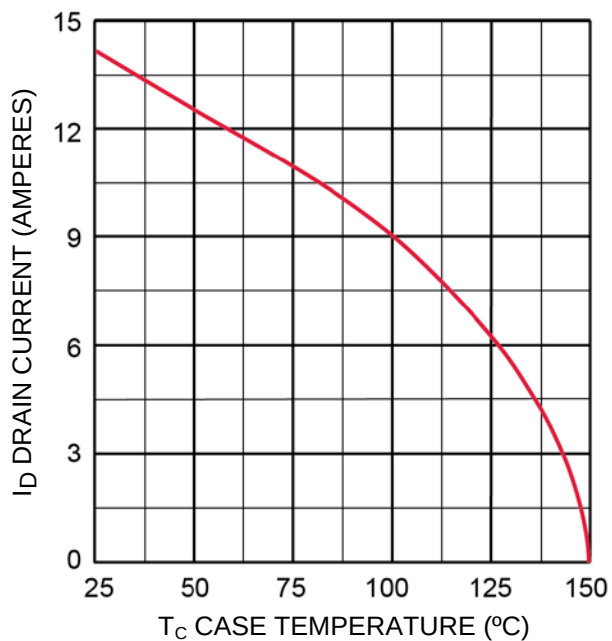
**FIGURE 1**  
Thermal Impedance Curves

**GRAPHS (continued)**
**FIGURE 2 – Maximum Drain Current vs Case Temperature Graphs**


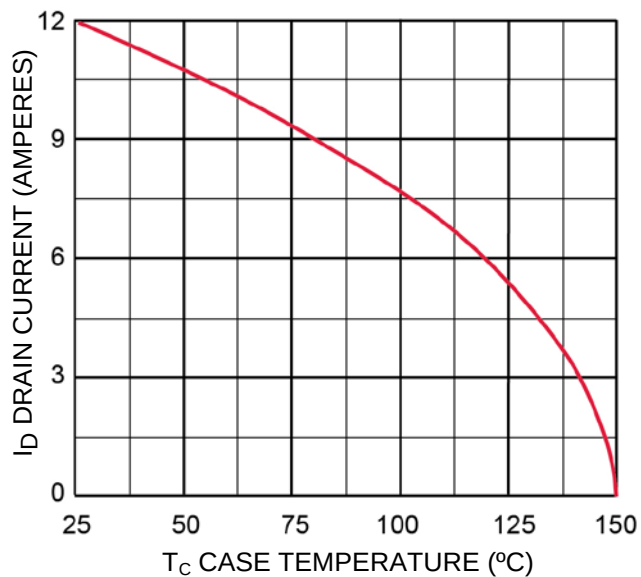
For 2N7224



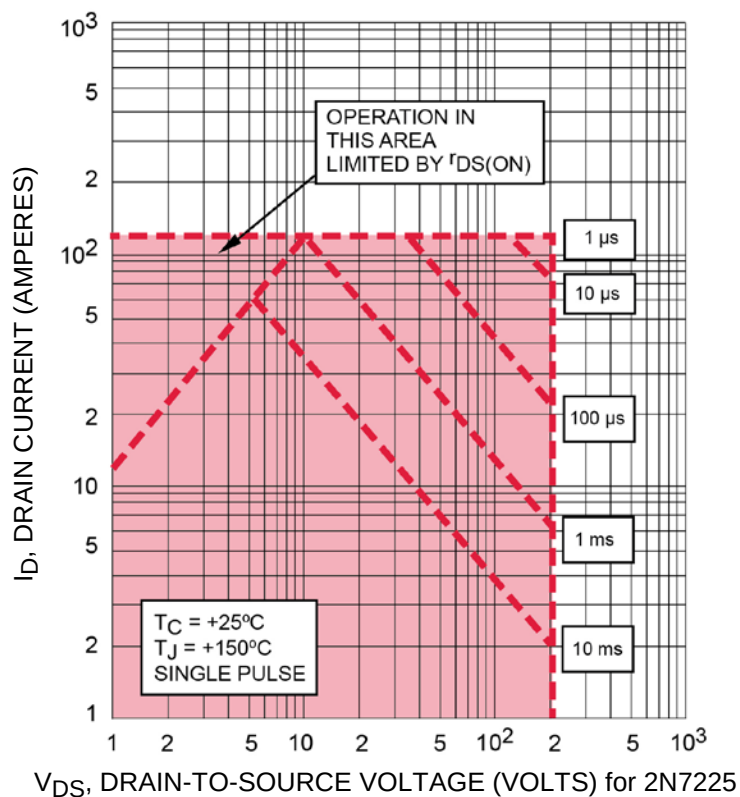
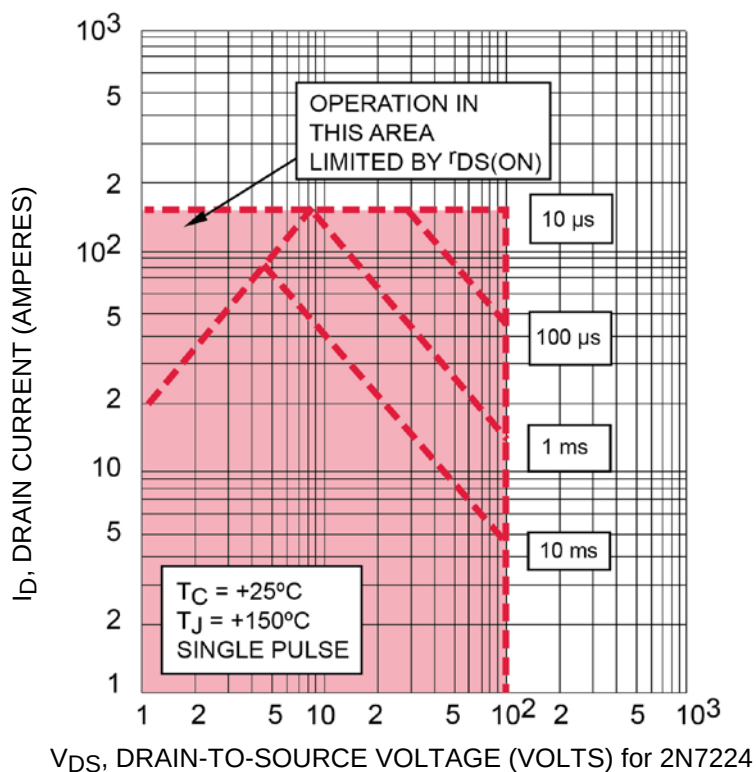
For 2N7225

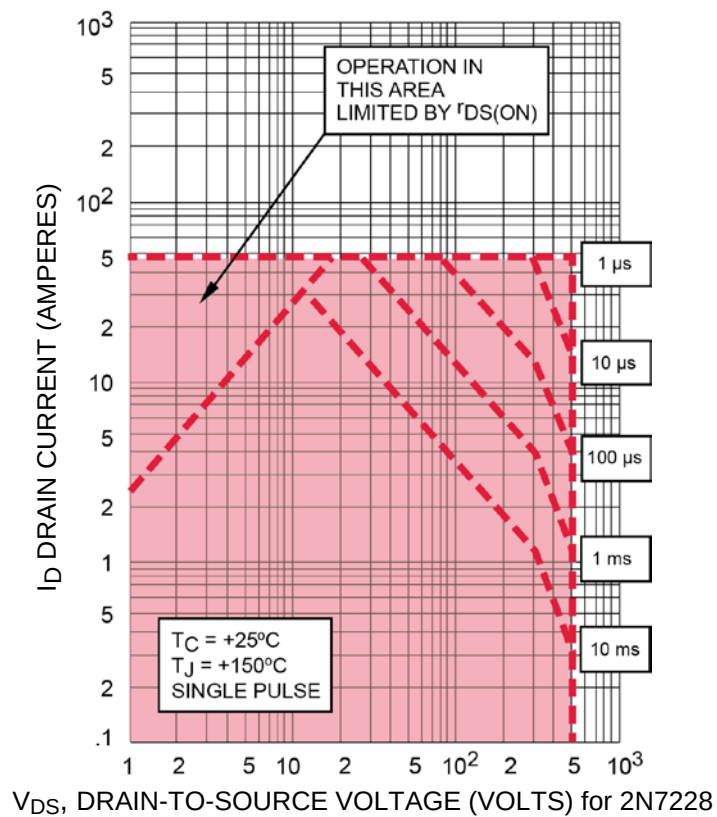
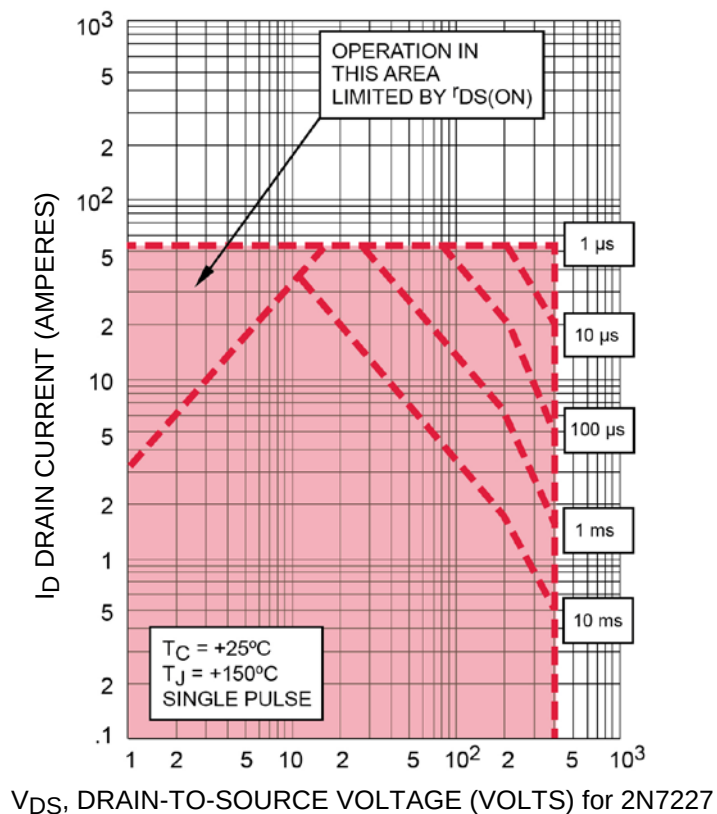


For 2N7227

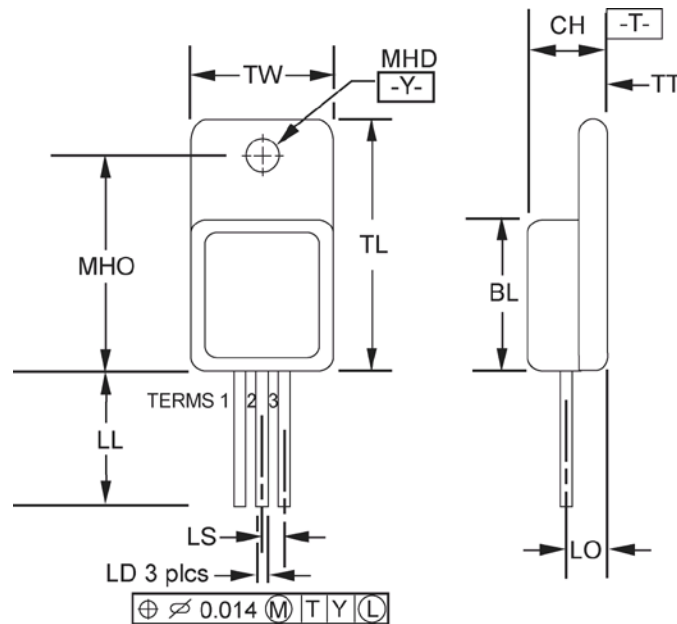


For 2N7228

**GRAPHS (continued)**
**FIGURE 3 – Maximum Safe Operating Area**


**GRAPHS (continued)**




**PACKAGE DIMENSIONS**

**NOTES:**

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Glass meniscus included in dimension D and E.
4. All terminals are isolated from case.
5. In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.

| Ltr    | Dimensions |      |             |       | Notes |
|--------|------------|------|-------------|-------|-------|
|        | Inch       |      | Millimeters |       |       |
|        | Min        | Max  | Min         | Max   |       |
| BL     | .535       | .545 | 13.59       | 13.84 |       |
| CH     | .249       | .260 | 6.32        | 6.60  |       |
| LD     | .035       | .045 | 0.89        | 1.14  |       |
| LL     | .510       | .570 | 12.95       | 14.48 |       |
| LO     | .150 BSC   |      | 3.81 BSC    |       |       |
| LS     | .150 BSC   |      | 3.81 BSC    |       |       |
| MHD    | .139       | .149 | 3.53        | 3.78  |       |
| MHO    | .665       | .685 | 16.89       | 17.40 |       |
| TL     | .790       | .800 | 20.07       | 20.32 | 3, 4  |
| TT     | .040       | .050 | 1.02        | 1.27  |       |
| TW     | .535       | .545 | 13.59       | 13.84 | 3, 4  |
| Term 1 | Drain      |      |             |       |       |
| Term 2 | Source     |      |             |       |       |
| Term 3 | Gate       |      |             |       |       |